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# Evaluation of Biorationals In Management Of Chrysanthemum Aphids, *Macrosiphoniella sanbornii* (Gillette).

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**ABSTRACT**
*Nymphs and adults of Chrysanthemum aphid Macrosiphoniella sanbornii (Gillette) colonize under surface of leaves apical shoots, buds and flowers. They suck sap resulting in devitalization of affected parts. In order to find the relative efficacy of different biorationals/ insecticides like azadirachtin @ 5ml/l, karanj oil @ 2ml/l, verticillium @ 5g/l, verticillium @ 5g/l followed by the azadirachtin @ 5ml/l, verticillium @ 5g/l followed by karanj oil @ 2ml and imidacloprid @ 0.4ml/l two sprays at ten days interval, field experiments were conducted at FRS, Hyderabad. The insecticides were evaluated on the basis of reduction in population over control at 1, 3, 5, 7 and 10 days after spraying (DAS). Among treatments, Imidacloprid was the most effective treatment in reducing aphid population by 92.31 per cent which was a significant reduction over untreated control as compared to the other treatments. The next effective treatments were verticillium followed by azadirachtin (68.54%), two sprays of azadirachtin (68.49%) and verticillium followed by karanj oil (67.34%) which were all significantly different from each other. Two sprays of verticillium was found to significantly reduce aphid population over control but was least effective (64.66%) in comparison to the rest of the treatments.*
***KEY WORDS :*** *Efficacy, Biorationals, Chrysanthemum plant, Macrosiphoniella sanbornii (Gillette)*

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## INTRODUCTION

Chrysanthemum belongs to the family Asteraceae, native to northern hemisphere, chiefly Europe and Asia with a few in other areas. Mostly the species in the lineage of present day cultivars are from China and the country is credited for having domesticated and hybridized the flowers for improvement. Presently 2000 varieties are grown around the world and in India about 1000 varieties are grown (Datta and Bhattacharjee, 2001).

In India, chrysanthemums are grown for cut flowers, loose flowers, as potted plants and as border plants in the garden. In North India various hues of red, yellow, white and purple coloured chrysanthemums are grown in abundance for decorating the landscape either in the ground or in pots. But in Southern India mostly the yellow coloured flowers are preferred and grown as loose flowers for trade. Profitable production of chrysanthemum is constrained by several factors, the most important being damage caused by insect pests such as aphids, caterpillars, mites, whiteflies, thrips and leafminer. Among these pests, chrysanthemum aphid (*Macrosiphoniella sanborni* Gillette) causes direct damage through feeding and indirectly by sooty mold formation (Agrios, 1988), to control aphid damage, insecticides are being used in large quantities indiscriminately, adding to environmental pollution as well as cost of production. Keeping in view, devising pest management strategies which would not only be economically feasible but also ecologically sound is essential to combat insect pest damage, accordingly efficacy of biorationals in management of chrysanthemum aphids is being analysed.

## MATERIALS AND METHODS

An experiment was conducted in simple RBD with biorationals for their bio efficacy against *Macrosiphoniella sanbornii* (Gillette) during *kharif* 2013-14 at Floricultural Research Station, ARI, Rajendranagar, Hyderabad.

One month old nursery grown Silper cuttings were transplanted to the 2x2 m plots in a manner to accommodate 36 plants in each plot with seven treatments and three replications on 8th August 2013. The insecticides used along with trade names and source are given in Table 1. All the recommended agronomic practices were followed. The treatments along with dosages are given in Table.2

**Table 1. Details of insecticides applied against chrysanthemum aphid *M.sanbornii* for relative efficacy evaluation.**

| S. No | Common Name | Trade Name | Formulation used | Dosage | Source |
|---|---|---|---|---|---|
| 1 | Azadirachtin | Nivaar | 10000ppm 1% EC | 5 ml/lit | Shri Disha Biotech Pvt. Ltd. Hyderabad. |
| 2 | Karanj oil | Karanj oil | 20000 ppm | 2 ml/lit | IICT, Hyderabad. |
| 3 | *Verticillium lecanii* | Vertifire - L | 1.15%W.P. | 5 g/lit | International Panaacea Ltd. New Delhi. |
| 4 | Imidacloprid | Confidor | 17.8 SL | 0.4 ml/lit | Bayer Crop Science Ltd. Bombay. |

In all the treatments, two sprayings were given during the course of investigation. First spraying was done on 15th December when pest incidence was noticed and second spraying was taken up 10 days after first spray on 26th December. The spraying was done with knapsack sprayer during evening hours to minimize drift of insecticides on neighbouring plots. The plants in each treatment were covered with respective spray fluid thoroughly.

**Table 2. Insecticide treatments imposed for bioefficacy studies against aphids in chrysanthemum.**

| Treatments | Treatments | Dosage |
|---|---|---|
| $T_1$ | Azadirachtin 10000 ppm | 5 ml/lit |
| $T_2$ | Karanj oil 20000 ppm | 2 ml/lit |
| $T_3$ | *Verticillium lecanii* | 5 g/lit |
| $T_4$ | *Verticillium* followed by azadirachtin | 5 g/lit and 5 ml/lit |
| $T_5$ | *Verticillium* followed by karanj oil | 5 g/lit and 2 ml/lit |
| $T_6$ | Imidacloprid 17.8 SL | 0.4 ml/lit |
| $T_7$ | Untreated control | |

$T_1$ - $T_3$ and $T_6$ : Spraying same treatment twice at ten days interval.
$T_4$, $T_5$ : One spraying followed by another after ten days interval.

**RESULTS AND DISCUSSION**

Two sprays were given during the cropping period at an interval of ten days, when the crop recorded maximum load of aphids . The pre treatment data was recorded one day prior to spraying and the post treatment data at one, three, five, seven, and ten days after each spray, and the efficacy of insecticidal treatments were determined in terms of per cent reduction in the insect population over untreated control in each treatment, cumulative reduction of aphids due to each spraying and combined effect of the two sprays was worked out and the results are presented here under.

**1. Efficacy of different biorational insecticides against chrysanthemum aphid after first spray.**

The population of aphids in precount data in all the treatments ranged between 74.5 to 81.2 on an average/plant and was on par with each other. Consequent on imposition of different treatments there was a decline in the aphid population which resulted in differential rate of decrease in different combinations (Table 3).

The perusal of the data at one day after spraying showed that imidacloprid treated plots recorded highest per cent reduction over control. (97.20%). The next effective treatment was karanj oil with 60.53 per cent mortality of aphids. The least population reduction was observed in azadirachtin treated plots (52.96%) which was on par with three verticillium treatments. 47.09 per cent 47.50 per cent 47.86 per cent, respectively.

Similar trend was observed at three days after spray where imidacloprid was the most effective and superior treatment which recorded 99.04 per cent population reduction followed by verticillium treatments which were on par with each other ranging between 72.74 and 75.88 per cent and the

treatment which showed the least per cent mortality reduction in aphid population was karanj oil (66.98%) that was on par with azadirachtin (69.23%) (Table 3).

The data generated on five days after spraying indicated that imidacloprid recorded the highest population reduction over control (91.32%), and next better treatment was azadirachtin with 79.99 per cent mortality which was on par with verticilliun ($T_3$) treatment which gave 77.80 per cent mortality. Three verticillium treated plots recorded similar per cent reduction over control and three of them were on par with each other. Karanj oil (66.98%) recorded least per cent reduction over control.

After seven days of first insecticidal spray, per cent field efficacy was highest in plots treated with imidacloprid (84.69%), next better treatment was azadirachtin (72.15%) followed by karanj oil (68.63%), verticillium treated plots showed least per cent reduction over control and they were on par with each other.

Ten days after the first spray imidacloprid remained the most effective treatment which recorded 78.35 per cent aphid population reduction and was superior to all other treatments, followed by azadirachtin which showed 65.43 per cent population reduction. The verticillium treated plots showed least per cent reduction of aphids over control which was on par with two other verticillium treated plots and karanj oil treated plots in terms of their efficacy.

Data on overall efficacy of insecticides against aphids after first spray revealed that imidacloprid spray was found to be significantly superior to other treatments reducing aphid population to an extent of 90.12 per cent followed by azadirachtin (67.95%). The least per cent population reduction was observed in verticillium treated plots ranging between 64-66 per cent The three verticillium treatments, and karanj oil were on par with each other with respect to reducing the aphid population (Table 3).

**2. Efficacy of different biorational insecticides against chrysanthemum aphid after second application.**

The mean aphid population per plant before second spray and the respective per cent field efficacy of selected treatments over control after second spray are presented in Table 4.

One day after second spray, Imidacloprid was the most effective treatment and was found significantly superior over all other treatments in reducing the aphid population (100%). The other promising treatment was karanj oil with 50.90 per cent reduction of aphid population over control. And the treatments azadirachtin and verticillium were found to be least effective.

At three days after insecticidal application, all the treatments were found significantly superior over control and imidacloprid spray continued to show extremely good result with 100 per cent aphid population reduction over control followed by verticillium (72.77%) and azadirachtin (71.90 %) which were on par with each other. Karanj oil was found to be least effective causing 66.46 per cent mortality (Table 4).

The results obtained at five days after second spray showed that imidacloprid was most effective with 95.87 per cent mortality followed by azadirachtin treatments which were on par with each other. Karanj oil treatment was found to be least effective and which was on par with verticillium in its efficacy.

Same trend continued seven days after second spray also, with imidacloprid recording 90.69 per cent reduction of aphid population and was significantly superior to the remaining treatments (Table 4). Azadirachtin ($T_4$) was next effective treatment with 76.81 per cent mortality followed by azadirachtin ($T_1$), karanj oil ($T_2$) and karanj oil ($T_5$) with per cent reduction over control (73.66%), (71.76%) and (71.55%) respectively. The least per cent reduction over control was observed in verticillium treated plots. (60.35%).

The observations made with regard to the reduction of aphid population at ten days after second spray again indicated imidacloprid as the best with highest population reduction of 85.92 per cent and significantly superior to all other treatments. Azadirachtin ($T_4$), karanj oil ($T_5$) and azadirachtin($T_1$)recorded 68.36, 67.60 and 66.67 per cent reduction over control. Verticillium treatment was found to be least effective which recorded 56 per cent reduction over control.

The overall efficacy of different insecticidal treatments after second round of spraying indicated that all the insecticidal treatments were significantly superior over the control in reducing the aphid population. The overall efficacy of insecticidal treatments against aphid in the descending order of their efficacy were imidacloprid ($T_6$), azadirachtin ($T_4$), azadirachtin ($T_1$), karanj oil ($T_5$), karanj oil ($T_2$) and verticillium ($T_3$) with per cent reduction of aphid population over control being 94.49, 70.94, 69.03, 68.98, 67.23 and 64.39 respectively. Among the treatments imposed karanj oil treated plots recorded similar per cent reduction with azadirachtin treated plots. They were found to be on par with each other.

**3. Cumulative efficacy of different biorational insecticides against chrysanthemum aphid after two sprays**:

The overall effect of treatments on aphid population after two applications revealed that imidacloprid was found significantly superior to the rest of treatments with 92.31 per cent mortality (Table 5). The

next effective treatments were verticillium followed by azadirachtin (68.54%), two sprays of alone azadirachtin (68.49%) and verticillium followed by karanj oil (67.34%). Two consecutive sprays of karanj oil (66.54%) and verticillium followed by karanj oil (67.34%) were found to be on par with each other.

Among all the treatments imidacloprid proved to be the best treatment while Verticillium alone (64.66%) was least effective against chrysanthemum aphids (Table 5)

Verticillium followed by azadirachtin and verticillium followed by karanj oil were found to be effective than two consecutive sprays of Verticillium at ten days interval.

Several studies have shown that imidacloprid 200 SL/17.8 SL @ 25g ai/ha/0.005% concentration was very effective in reducing aphid populations particularly cotton aphid (Kumar *et al,* 2009 and Preeta *et al,* 2012). This was once again proved in the present study where, out of all the insecticides tested imidacloprid 17.8 SL@0.4 ml/l gave 92.31 per cent reduction in aphid population in chrysanthemum after two continuous sprays. However, biorational options like azadirachtin, karanj oil and verticillium were able to cause nearly 70 per cent mortality of aphids over control*. Verticillium lecanii* @ 5g/lit followed by either azadirachtin @ 5 ml/lit or karanj oil @ 2ml/lit was found to work more effectively in reducing aphid populations as compared to two consecutive sprays of verticillium alone. Several reports exist on the efficiency of azadirachtin/ neem oil, karanj oil and verticillium as independent sprays accounting for more than 50 per cent control of aphid populations (Kathiriya and Bharpoda, 2010, Kumar *et al*. 2007, Sopp *et al.,* 1990).

Sabir *et al*. (2012) found that integrated treatments were more effective than individual treatments in the management of key insect pests of chrysanthemum as evidenced by the efficacy of combination of agricultural spray oil and azadirachtin. The present study shows that verticillium followed by azadirachtin/ karanj oil was effective in reducing aphid population by 68.54 & 67.34 per cent. Hence the above result is a promising alternative to the usage of chemical insecticide alone as the fungus and botanical pesticide combination may be effectively used along with natural control agents like parasitoids and predators to keep the aphid population under check.

**Table 3. Efficacy of different biorational insecticides against chrysanthemum aphid, *M. sanbornii* after first spray during *kharif* 2013-14.**

| Treatment | Pre-counts | Mean no. of aphids per plant after spraying | | | | | Per cent reduction of aphid population over control at | | | | | Cumulative efficacy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 DAS | 3 DAS | 5 DAS | 7 DAS | 10DAS | 1 DAS | 3 DAS | 5 DAS | 7 DAS | 10 DAS | |
| $T_1$- Azadirachtin @ 5 ml/lit | 78.2 (62.17) | 38.13 | 24.81 | 16.81 | 23.74 | 31.58 | 52.96 (46.70)$^a$ | 69.23 (56.31)$^a$ | 79.99 (63.43)$^c$ | 72.15 (58.12)$^c$ | 65.43 (53.99)$^b$ | 67.95 (55.52)$^c$ |
| $T_2$- Karanj oil @ 2 ml/lit | 74.5 (59.67) | 30.48 | 25.37 | 21.23 | 25.47 | 35.13 | 60.53 (51.08)$^b$ | 66.98 (54.93)$^a$ | 73.49 (59.01)$^a$ | 68.63 (55.94)$^b$ | 59.63 (50.56)$^a$ | 65.85 (54.24)$^{ab}$ |
| $T_3$- Verticillium @ 5 g/lit | 76.4 (60.94) | 36.15 | 21.48 | 18.23 | 32.30 | 37.01 | 54.36 (47.50)$^a$ | 72.74 (58.53)$^b$ | 77.80 (61.84)$^{bc}$ | 61.22 (51.49)$^a$ | 58.53 (49.91)$^a$ | 64.93 (53.69)$^a$ |
| $T_4$- Verticillium @ 5 g/lit | 79.1 (62.80) | 38.02 | 19.68 | 20.06 | 31.07 | 36.17 | 53.64 (47.09)$^a$ | 75.88 (60.59)$^b$ | 76.40 (60.94)$^b$ | 63.97 (53.12)$^a$ | 60.85 (51.27)$^a$ | 66.15 (54.42)$^b$ |
| $T_5$- Verticillium @ 5 g/lit | 78.3 (62.24) | 36.54 | 21.03 | 19.43 | 32.08 | 36.43 | 54.98 (47.86)$^a$ | 73.96 (59.32)$^b$ | 76.91 (61.28)$^b$ | 62.46 (52.20)$^a$ | 60.17 (50.81)$^a$ | 65.69 (54.15)$^{ab}$ |
| $T_6$- Imidacloprid @ 0.4 ml/lit | 81.2 (63.30) | 2.36 | 0.80 | 7.57 | 13.55 | 20.53 | 97.20 (80.37)$^c$ | 99.04 (84.38)$^c$ | 91.32 (72.87)$^d$ | 84.69 (66.97)$^d$ | 78.35 (62.27)$^c$ | 90.12 (71.68)$^d$ |
| $T_7$- Control | 76.2 (60.80) | 79.00 | 78.60 | 81.90 | 83.08 | 89.02 | – | – | – | – | – | – |
| CD (P=0.05) | 4.12 | | | | | | 1.43 | 2 | 1.69 | 1.98 | 1.45 | 0.654 |
| SE± | 0.69 | | | | | | 0.46 | 0.65 | 0.55 | 0.64 | 0.47 | 0.297 |

DAS – Days after Spraying Figures in the parentheses are arc sine transformed values

**Table 4. Efficacy of different biorational insecticides against chrysanthemum aphid, *M. sanbornii* after second spray during *kharif* 2013-14.**

| Treatment | Pre-counts | Mean no. of aphids per plant after spraying | | | | | Per cent reduction of aphid population over control at | | | | | Cumulative efficacy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 DAS | 3 DAS | 5 DAS | 7 DAS | 10DAS | 1 DAS | 3 DAS | 5 DAS | 7 DAS | 10 DAS | |
| $T_1$- Azadirachtin @ 5 ml/lit | 30.33 (33.42) | 14.21 | 9.18 | 5.82 | 8.40 | 10.78 | 53.19 (46.83)$^{a}$ | 70.14 (56.88)$^{bc}$ | 81.51 (64.54)$^{c}$ | 73.66 (59.12)$^{b}$ | 66.67 (54.74)$^{c}$ | 69.03 (56.19)$^{b}$ |
| $T_2$ - Karanj oil @ 2 ml/lit | 33 (35.06) | 13.14 | 11.22 | 8.35 | 9.80 | 13.34 | 60.22 (50.90)$^{b}$ | 66.46 (54.61)$^{a}$ | 75.62 (60.42)$^{a}$ | 71.76 (57.90)$^{b}$ | 62.09 (52.00)$^{b}$ | 67.23 (55.08)$^{b}$ |
| $T_3$- Verticillium @ 5 g/lit | 34.27 (35.83) | 15.52 | 9.46 | 7.80 | 14.29 | 16.08 | 54.75 (47.73)$^{a}$ | 72.77 (58.55)$^{de}$ | 78.07 (62.08)$^{b}$ | 60.35 (50.97)$^{a}$ | 56.00 (48.45)$^{a}$ | 64.39 (53.36)$^{a}$ |
| $T_4$- Azadirachtin @ 5 ml/lit | 36.58 (37.22) | 16.66 | 10.42 | 6.40 | 8.92 | 12.34 | 54.50 (47.58)$^{a}$ | 71.90 (57.99)$^{cd}$ | 83.14 (65.76)$^{c}$ | 76.81 (61.21)$^{c}$ | 68.36 (55.78)$^{c}$ | 70.94 (57.38)$^{c}$ |
| $T_5$- Karanj oil @ 2 ml/lit | 33.49 (35.36) | 13.44 | 10.55 | 8.01 | 10.02 | 11.57 | 59.90 (50.72)$^{b}$ | 68.92 (56.12)$^{ab}$ | 76.96 (61.32)$^{ab}$ | 71.55 (57.77)$^{b}$ | 67.60 (55.31)$^{c}$ | 68.98 (56.16)$^{bc}$ |
| $T_6$- Imidacloprid @ 0.4 ml/lit | 22.18 (28.10) | 0.00 | 0.00 | 0.95 | 2.17 | 3.33 | 100 (90.00)$^{c}$ | 100 (90.00)$^{f}$ | 95.87 (78.28)$^{d}$ | 90.69 (72.24)$^{d}$ | 85.92 (67.96)$^{d}$ | 94.49 (76.44)$^{d}$ |
| $T_7$- Control | 89.21 (70.82) | 89.30 | 90.40 | 92.62 | 93.82 | 95.14 | – | – | – | – | – | – |
| CD (P=0.05) | 1.70 | | | | | | 1.28 | 1.51 | 1.21 | 1.85 | 1.58 | 1.138 |
| SE± | 0.55 | | | | | | 0.41 | 0.49 | 0.39 | 0.6 | 0.51 | 0.517 |

DAS – Days after Spraying Figures in the parentheses are arc sine transformed values

**Table 5. Cumulative efficacy of different biorational insecticides against chrysanthemum aphid, *M. sanbornii* during *kharif* 2013-14.**

| Treatments | Mean percentage reduction over control after | | Cumulative mean |
|---|---|---|---|
| | First spray | Second spray | |
| $T_1$-Azadirachtin @ 5 ml/lit | 67.95 (55.52)$^{c}$ | 69.03 (56.19)$^{bc}$ | 68.49 (55.86)$^{c}$ |
| $T_2$- Karanj oil @ 2 ml/lit | 65.85 (54.24)$^{ab}$ | 67.23 (55.08)$^{b}$ | 66.54 (54.66)$^{b}$ |
| $T_3$- Verticillium @ 5 g/lit | 64.93 (53.69)$^{a}$ | 64.39 (53.36)$^{a}$ | 64.66 (53.53)$^{a}$ |
| $T_4$- Verticillium (@ 5 g/lit) followed by Azadirachtin (@ 5 ml/lit) | 66.15 (54.42)$^{b}$ | 70.94 (57.38)$^{c}$ | 68.54 (55.89)$^{d}$ |
| $T_5$- Verticillium (@ 5 g/lit) followed by Karanj oil (@ 2 ml/lit) | 65.69 (54.15)$^{ab}$ | 68.98 (56.16)$^{bc}$ | 67.34 (55.15)$^{bc}$ |
| $T_6$- Imidacloprid @ 0.4 ml/lit | 90.12 (71.68)$^{d}$ | 94.49 (76.44)$^{d}$ | 92.31 (73.90)$^{e}$ |
| $T_7$-Control | – | – | – |
| CD (P=0.05) | 0.654 | 1.138 | 0.886 |
| SE± | 0.297 | 0.517 | 0.402 |

Figures in the parentheses are arc sine transformed values

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